Synthesis of Classic Writings on Systems Theory: Bertalanffy's General Systems Theory

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General systems theory is a multidisciplinary approach to understanding theories and principles that apply to many systems. As a biologist, Ludwig Von Bertalanffy recognized that there are common principles of organization in various disciplines such as physics, chemistry, biology, and sociology. Consequently, Bertalanffy developed a set of universal principles applying to systems in general and emphasized that real systems are open to, and interact with their environments. By applying the principles of general system theory, researchers can reduce duplication of effort and leaders can increase their effectiveness in achieving organization goals

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Systems and Systems Thinking

A system is a group of elements or components that operate in unison to form a larger distinct entity that is subject to analysis (Bertalanffy, 1969). These entities, or metasystems, are so ubiquitous in our environment that we take them for granted. For instance, we frequently refer to a wide variety of systems such as the air conditioning system, the computer system, the electrical system, the transportation system, the economic system, the monetary system, and the healthcare system. Rarely do we consider the complexity of these systems, their interactivity, or their global effect on our environment. In fact, Bertalanffy (1969) emphasizes that real systems are open to, and interact with; their environments so that they acquire new properties resulting in continued evolution and increased complexity of the systems.

The classical analytic procedure to studying systems, or entity, has been to reduce the system to its constituent elements and study them in isolation from the metasystem. "'Analytical procedure' means that an entity being investigated be resolved into, and hence can be constituted

or reconstituted from, the parts put together, these procedures being understood in both their material and conceptual sense" (Bertalanffy, 1969, p. 19). The problem with this approach is that by exploring an element's characteristics without considering its intersystem interactions, the analysis fails to reveal the complete nature of a subsystem. Systems thinking, however, emphasize a more holistic perspective to systems analysis; it encourages us to look beyond the bits and pieces in order to understand and develop systems. Bertalanffy (1969) states, "The tendency to study systems as an entity rather than a conglomeration of parts is consistent with the tendency in contemporary science no longer to isolate phenomena in narrowly confined contexts, but rather to open interactions for examination and to examine larger and larger slices of nature" (p. 9).

General Systems Theory

Bertalanffy's (1969) study of biology revealed the interconnectedness of biological subsystems that led him to recognize parallel organization characteristics, or isomorphisms, in other disciplines such as physics, chemistry, technology, and sociology. He hypothesized that if multiple disciplines focused their research and theory efforts, they would be able to identify principles that will have universal application. Bertalanffy (1969) declares,

> Thus, there exist models, principles, and laws that apply to generalized systems or their subclasses, irrespective of their particular kind, the nature of their component elements, and the relations or 'forces' between them. It seems legitimate to ask for a theory, not of systems of a more or less special kind, but of universal principles applying to systems in general. In this way, we postulate a new discipline called *General Systems Theory*. Its subject matter is the formulation and derivation of those principles, which are valid for 'systems' in general. (p.32)

According to Bertalanffy (1969), for general systems theory (hereafter GST) to be successful, it must be multi-disciplinary. Therefore, it incorporates principles from classical systems theory, compartment theory, set theory, graph theory, net theory, cybernetics, information theory, game theory, and queuing theory. In explaining adaptive behavior of systems, GST incorporates principles of equifinality, feedback, step functions, and brain design. Furthermore, general systems theory emphasizes universal organization characteristics. Bertalanffy (1969) states, "Characteristics of organization, whether of a living organism or a society, are notions like those of wholeness, growth, differentiation, hierarchical order, dominance, control, competition, etc" (p. 47).

It appears that the analytical approach of classical systems theory focuses on the linear relationships of system elements rather than the non-linear, web-like approach espoused by GST. This writer believes that conventional thinkers (with conventional wisdom) think in straight lines. They are not prepared for the curves that can take them to surprises they cannot see. The systemic approach of general systems theory should enable researchers to broaden their perspective and discover new possibilities in their respective fields. Table 1 shows de Rosnay's (1997) salient characteristics of the analytic and systemic approaches. The systemic approach encourages researchers to progressively explore "…problems previously not envisaged, not manageable, or considered as being beyond science or purely philosophical…" (Bertalanffy, 1969, p. 23).

In addition to expanding the scope of research, general systems theory provides the important benefit of eliminating research redundancy where identical theoretical principles are discovered multiple times, because a formal information transfer structure is non-existent.

Table 1
Characteristics of Analytic and Systemic Research Approaches

Analytic Approach	Systemic Approach
Isolates, then concentrates on the elements.	Unifies and concentrates on the interaction between elements.
Studies the nature of interaction.	Studies the effects of interaction.
Emphasizes the precision of details.	Emphasizes global perception.
Modifies one variable at a time	Modifies groups of variables simultaneously.
Remains independent of duration of time; the phenomena are considered reversible.	Integrates duration of time and irreversibility.
Validates facts by means of experimental proof within the body of a theory.	Validates facts through comparison of the behavior of the model with reality.
Uses precise and detailed models that are less useful in actual operation.	Uses models that are insufficiently rigorous to be used as bases of knowledge but are useful in decision and action.
Has an efficient approach when interactions are linear and weak.	Has an efficient approach when interactions are non linear and strong.
Leads to discipline-oriented education.	Leads to multidisciplinary education.
Leads to action programmed in detail.	Leads to action through objectives.
Possesses knowledge of details, poorly defined goals.	Possesses knowledge of goals, fuzzy details.

Bertalanffy (1969) states,

> Therefore, general systems theory should be, methodologically, an important means of controlling and instigating the transfer of principles from one field to another, and it will no longer be necessary to duplicate or triplicate the discovery of the same principles in different fields isolated from the other. (p. 80)

This approach has direct implications for social organization theory in that general systemic organization phenomena from other fields can assist our understanding of social and business organizations. Theorists such as Morgan (1998) and Hatch (1997) use metaphors such as biological organisms, the brain, and machines to describe organizations. General systems theory provides a methodological approach to identify the general scientific principles that each metaphor uses to explain organizations. These principles include input, system throughput, output, feedback, system boundaries, progressive segregation, progressive mechanization, and homeostasis.

Open, Closed, and Complex Systems

General systems theory addresses both closed and open systems. A closed system, frequently the focus of conventional physics and the analytical research approach, is isolated from its environment. In a state of equilibrium, a closed system does not need energy for its preservation, nor can energy be obtained from it (Bertalanffy, 1969). An open system, however, has a dynamic interaction with its environment both transmitting and receiving energy. "The basis of the open system model is the dynamic interaction of its components. The basis of the cybernetic model is the feedback cycle in which, by way of feedback information, a desired value is maintained, a target is reached, etc" (Bertalanffy, 1969. p. 150).

Simple systems typically have limited environmental interaction and physical functions. Biological entities, on the other hand, are built up of differentiated and segregated parts. Bertalanffy (1969) states, "The reason for the predominance of segregation in living nature seems to be that segregation into partial systems implies an increase in complexity in the system" (p. 69). Progressive segregation can lead to progressive mechanization, which creates less dynamic feedback systems and regulation difficulties. However, increased mechanization implies fixed arrangements and conditions of constraint that may make a system more efficient at accomplishing a particular task (Bertalanffy, 1969). Consequently, the ultimate product of progressive segregation and progressive mechanization is an increase in an open system's system complexity.

Systems Concept Applied to Humans and Organizations

Contemporary human sciences and organization theory acknowledge the importance of systems and interconnectivity. Organizations, especially in a global environment, are networks where each part is interdependent on every other part so that as change happens in one part or one part fails to operate, the effect is felt throughout the network. The interconnectivity may be so tight that a system failure can be devastating or loose enough that the system can adjust to it, through feedback, return to equilibrium and continue to function. Consequently, contemporary organization theory and practice tend to incorporate a systems approach to organization analysis. Bertalanffy (1969) states, "This trend is marked by the emergence of a bundle of new disciplines such as cybernetics, information theory, general systems theory, theories of games, of decisions, of queuing and others…" (p.188). Emphasis is placed on studying the system, the network, and the whole in their totality.

The systems approach is a considerably different form of organization analysis from that of the 19th and early 20th centuries when labor and capital were less entwined, where workers were predominantly European males, and global economic interaction was limited in scope. The tendency was to analyze organizations in a narrowly defined context rather that to examine interactions at a total-system level; most managers simply focused on their area of responsibility (Jacques, 1996).

Bertalanffy (1969) states,

> …another recent development is the theory of formal organizations, that is, structures planfully instituted, such as those of an army, bureaucracy, business enterprise, etc. This theory is framed in a philosophy which accepts the premise that the only meaningful way to study organization is to study it as a system. (p. 9)

This idea is consistent with the post-modern approach of opening up discourse to examine various levels of understanding; to look beyond the things commonly taken-for-granted. Furthermore, the tendency to study organizations as a systems entity indicated a shift in perspective from systematic modernism to more of a neo-modernism perspective. This writer believes that the systematic modernism approach to organizations (e.g. Weber's "Iron Cage") has been modified, through post-modernistic influence, to encompass a broader understanding of the organization as a system. Bertalanffy's (1969) general systems theory appears to reflect this phenomenon.

Bertalanffy (1969, p. 192) cites Selye (1956): "The secret of health and happiness lies in successful adaptation to the ever-changing conditions of the globe; the penalties for failure in this great process of adaptation are disease and unhappiness." This statement underscores the importance of expanding our organization perspective beyond parochialism to globalism.

General systems theory assists us in accomplishing the expansion process by drawing our focus to the network of global interactions that affect our management and leadership decision.

In addition to its effect on organization theory, general systems theory has positive implications for leadership theory. Bass (1990) states,

> A systems approach looks at the leader as someone embedded in a system with multiple inputs from the environment, the organization, the immediate work group supervised, the task, the leader's behavior, and his or her relationships with subordinates and outputs in terms of effective performance and satisfaction. (p. 908)

Furthermore, leaders need to understand how their decisions will affect the organization at various levels; to understand the boundaries of their effective control and the interactive impact of their decisions. Bass (1990) emphasizes the importance of periodic feedback in helping leaders succeed in their mission.

General system theory represents an effective framework to guide our research as organization theorists, and consultants. We become cognizant that organizations, cultures, and people have their own "ambience" which is composed of just those environmental characteristics that affect an entity's daily affairs (Bertalanffy, 1969, p. 228). Understanding this phenomenon is important because it produces massively different interactive affects in a global system. Kilburg (1995) states,

> In modern mega-organizations that are composed of hundreds of thousands and, at times, millions of people, there can be a myriad number of levels with which a consultant must be concerned. Consultants need to be alert to each of these dimensions in their work because these dimensions all interact, dramatically influencing the events of organizational life at all times. (p. 3)

Therefore, irrespective of our analysis role, we should have a systems perspective in order to understand both the meta-system, the subsystem within it that we are presently concerned, and the inter-system interaction caused by our intervention.

Conclusion

General systems theory distills the common organization principles of various disciplines. Its strength appears to be in its ability to identify the features of any system whether it is actively or passively controlled, or opened or closed. It facilitates an organized approach to evaluating organization structure and intersystem interaction.

In addition, general systems theory represents a different intellectual approach to evaluating organizations. Bertalanffy (1969) states, " Of course, the change in intellectual climate which allows one to see new problems which were overlooked previously, or see the problem in a new light, is in a way more important than any single application" (p. 99). This seems remarkably similar to other great intellectual perspectives such as those generated by the Galilean or Copernican theories; "…it was the changes in the general frame of reference that mattered. Nevertheless, the justification of such changes ultimately is in specific achievements which would not have been attained without the new theory" (Bertalanffy, 1969, p. 99-100).

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